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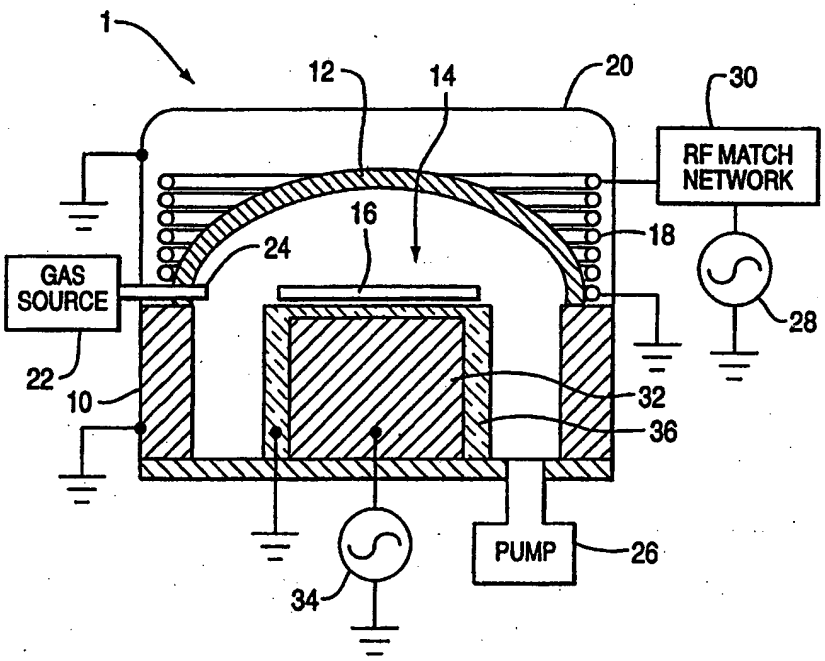
(54) Title: NEW ETCH PROCESS FOR FORMING HIGH ASPECT RATIO TRENCHES IN SILICON



(57) Abstract

A multistep etch process for forming high aspect ratio trenches in silicon having a silicon oxide and/or silicon nitride hardmask. In a first step, an etch composition of HBr and oxygen is used, depositing a passivation layer on the sidewalls and producing slightly tapered openings. In the second step, an etch composition of a fluorine–containing gas such as SF_6, HBr and oxygen is used, producing more vertical openings at a high etch rate. The taper of the openings during the second step can be controlled by adjusting the relative amount of HBr or SF_6 employed. This process is a clean process that does not require cleaning of the etch chamber between etch steps.

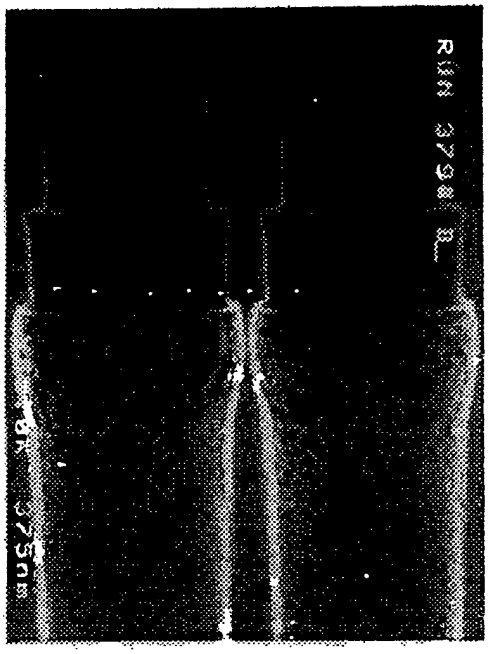


FIG. 1

FIG. 8

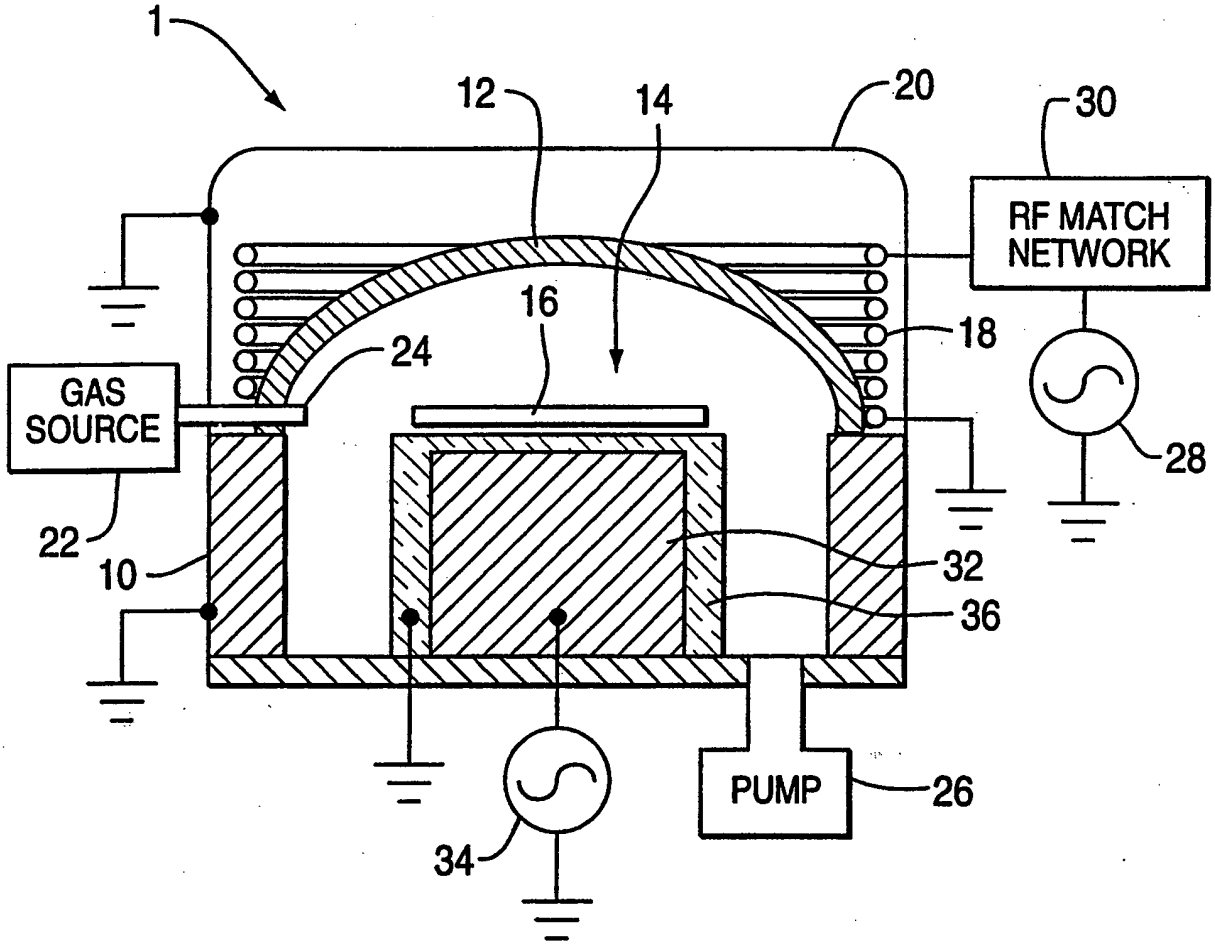

1
12
14
20
30
RF MATCH NETWORK
16
18
24
GAS SOURCE
28
22
10
32
36
PUMP
26
34

FIG. 2

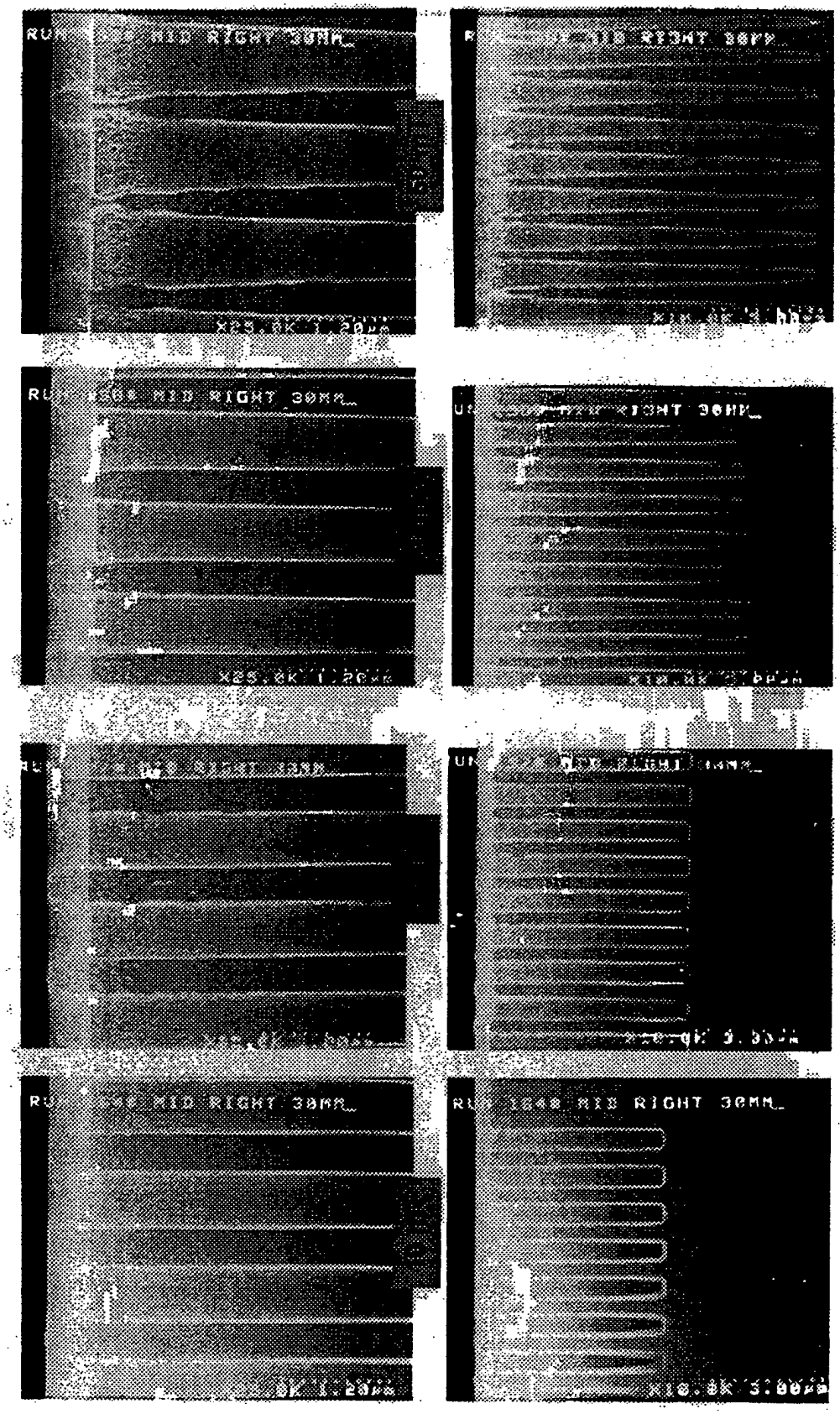


FIG. 3

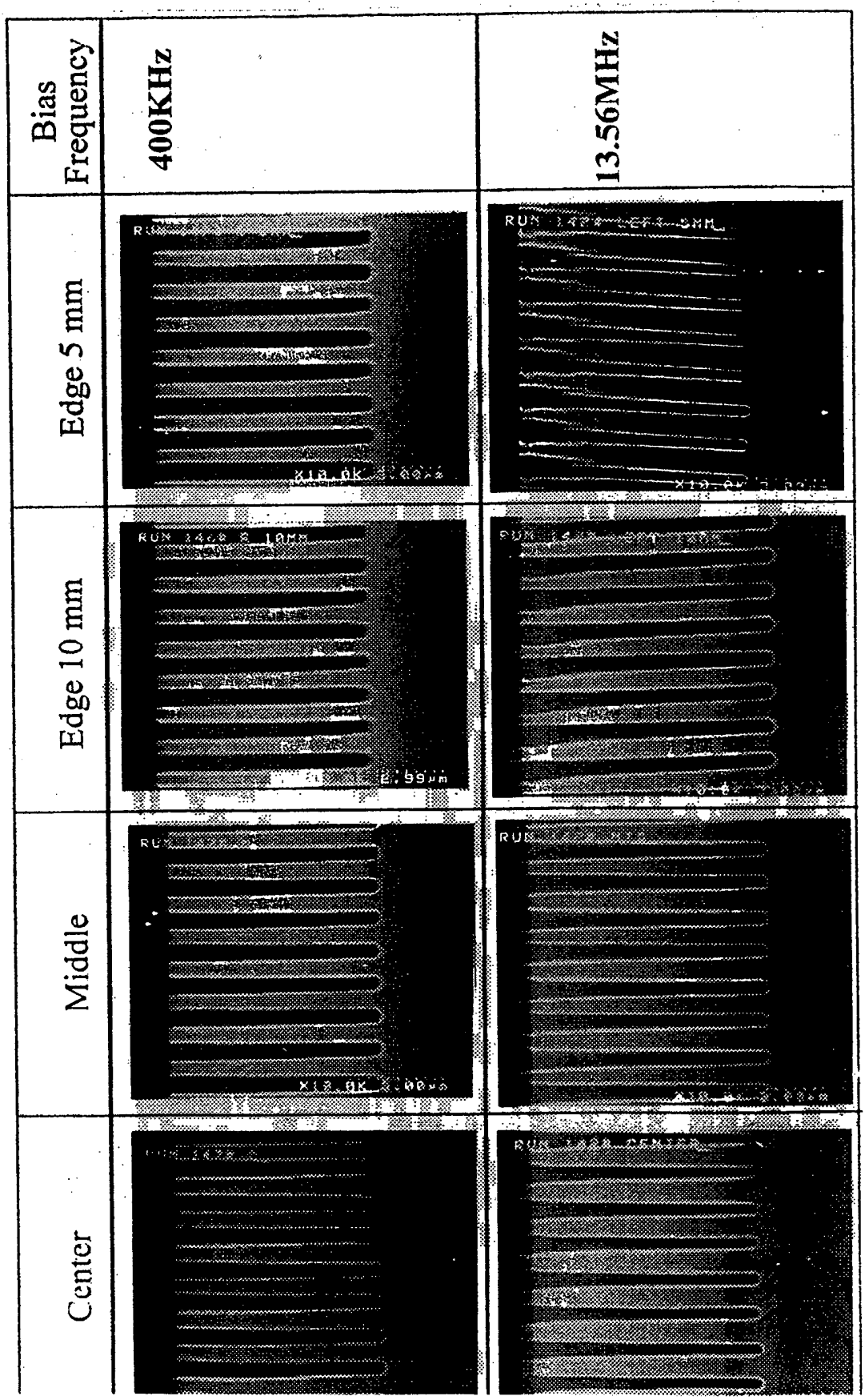

Bias Frequency
400KHz
13.56MHz
Edge 5 mm
Edge 10 mm
Middle
Center

FIG. 4

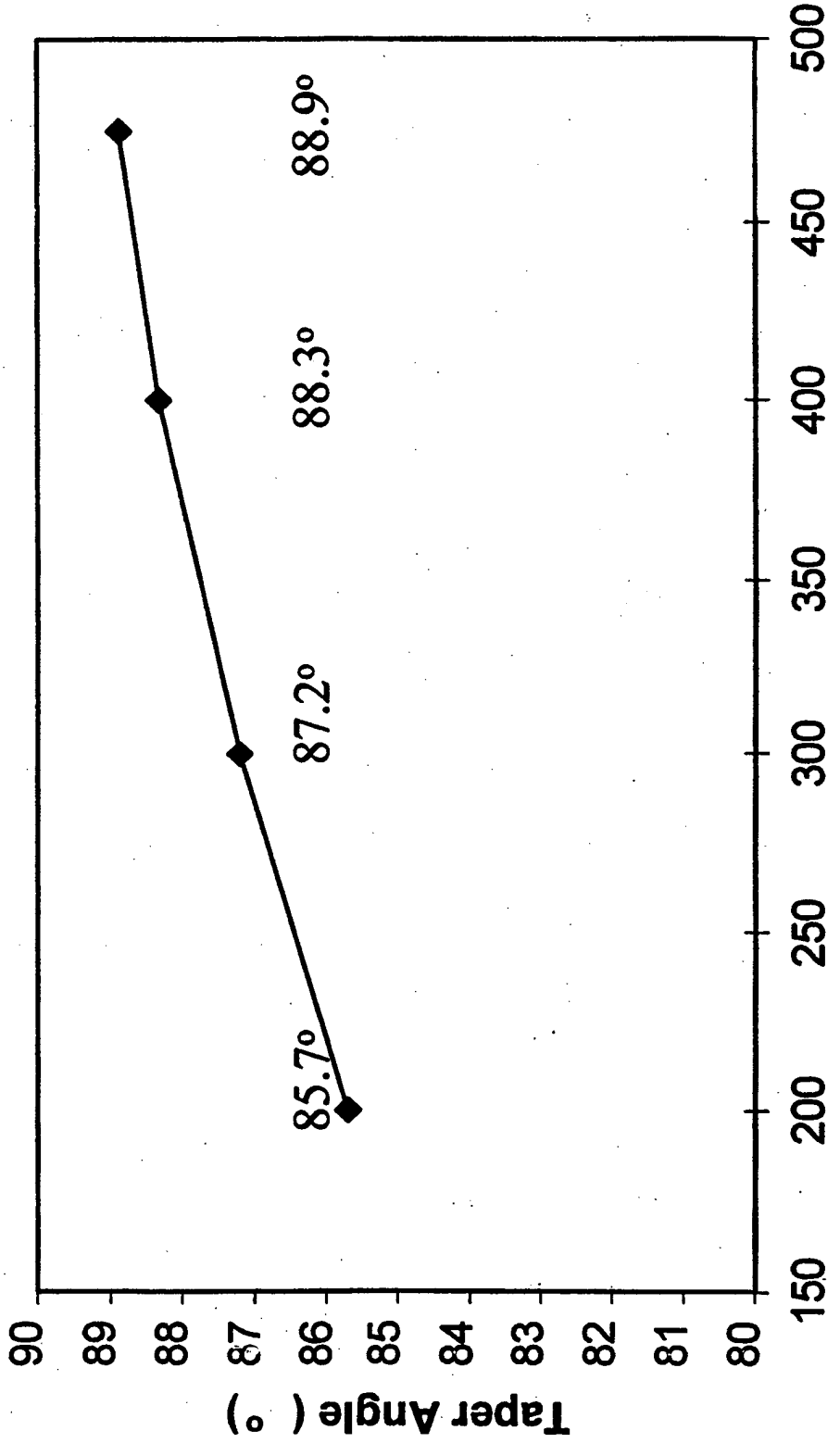

Taper Angle (°)
90
89
88
87
86
85
84
83
82
81
80
150
200
250
300
350
400
450
500
Bias Power (W)
85.7°
87.2°
88.3°
88.9°

FIG. 5

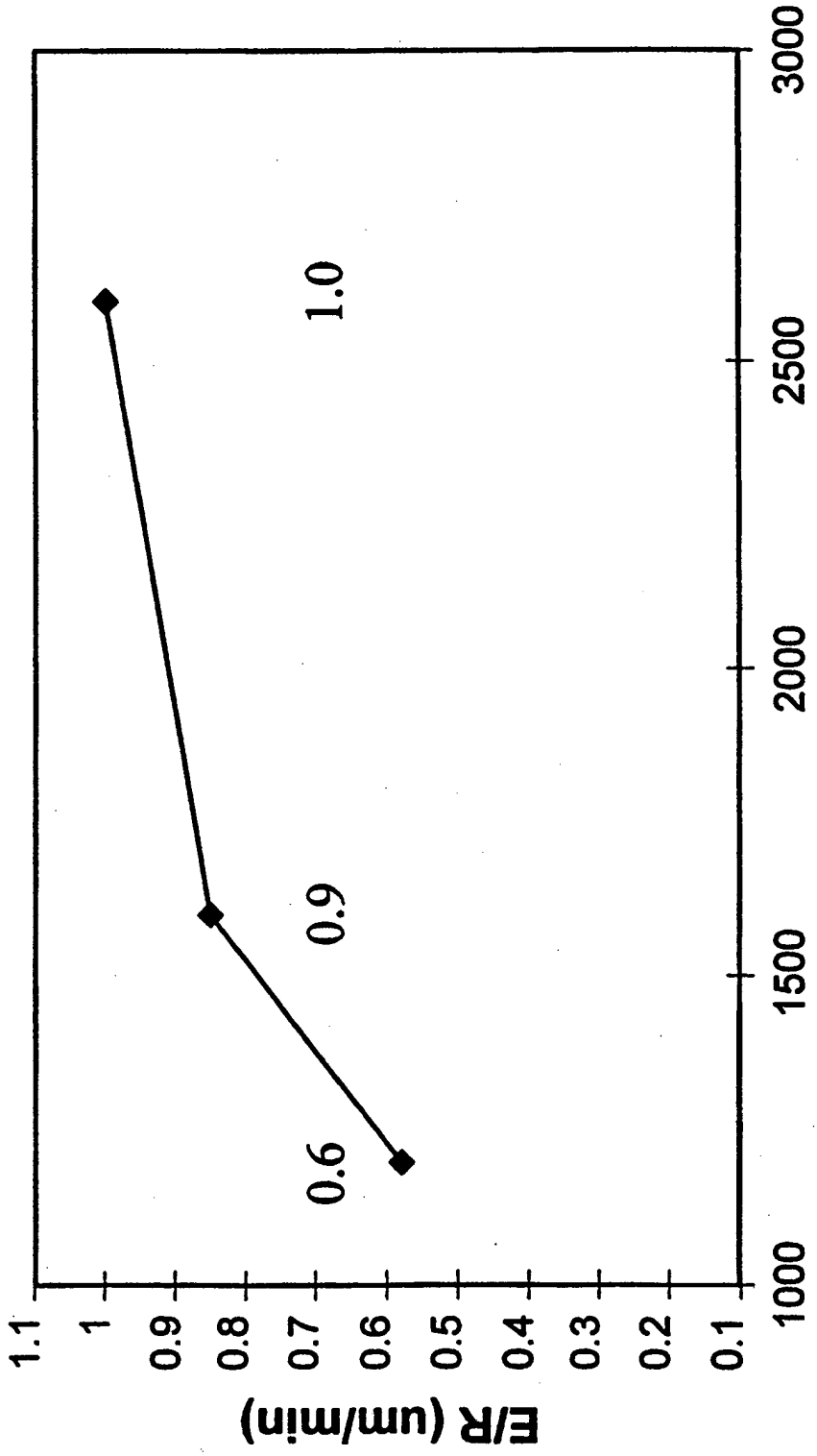

E/R (um/min)
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
1000
1500
2000
2500
3000
Source Power (W)
1.0
0.9
0.6

FIG. 6

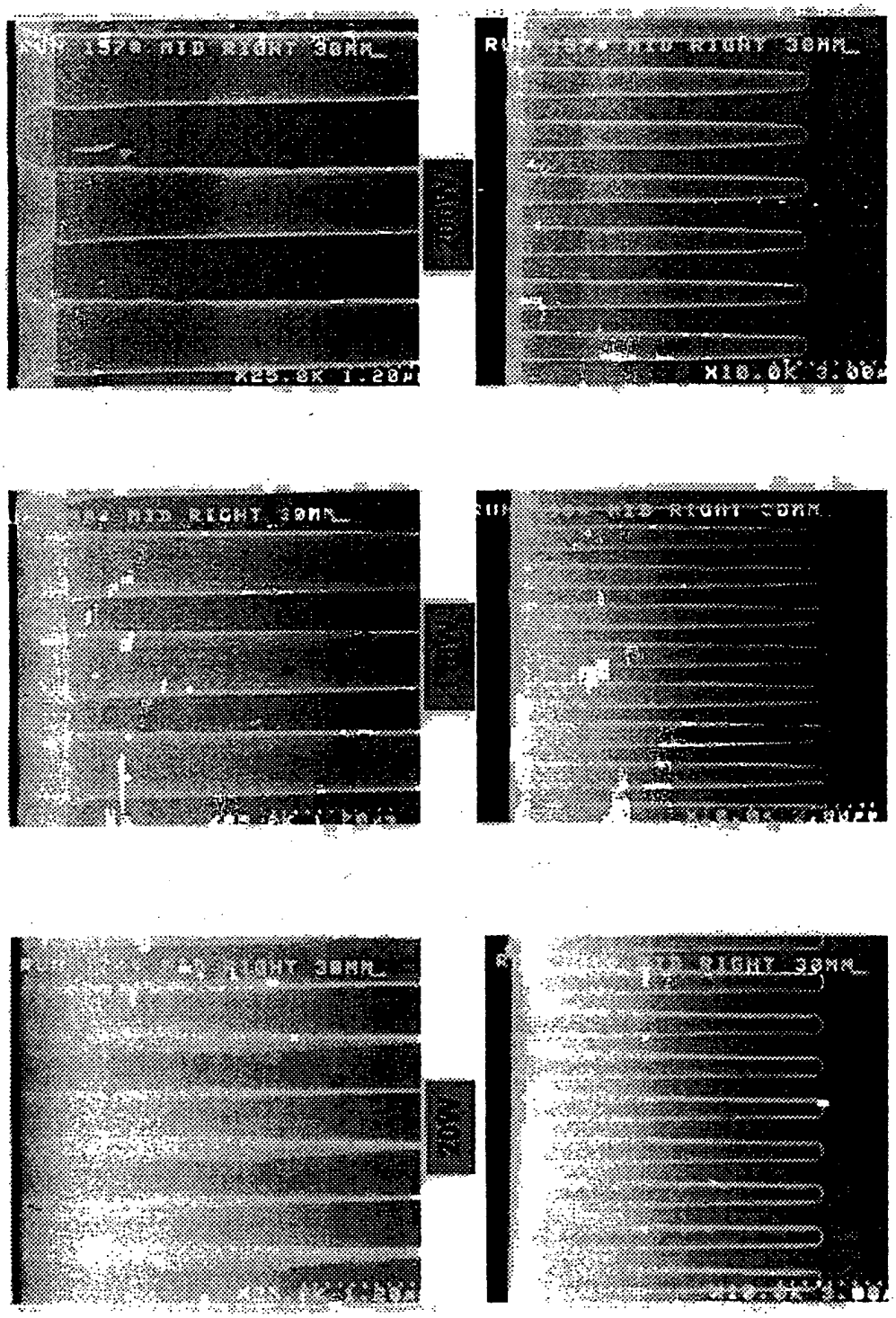


FIG. 7

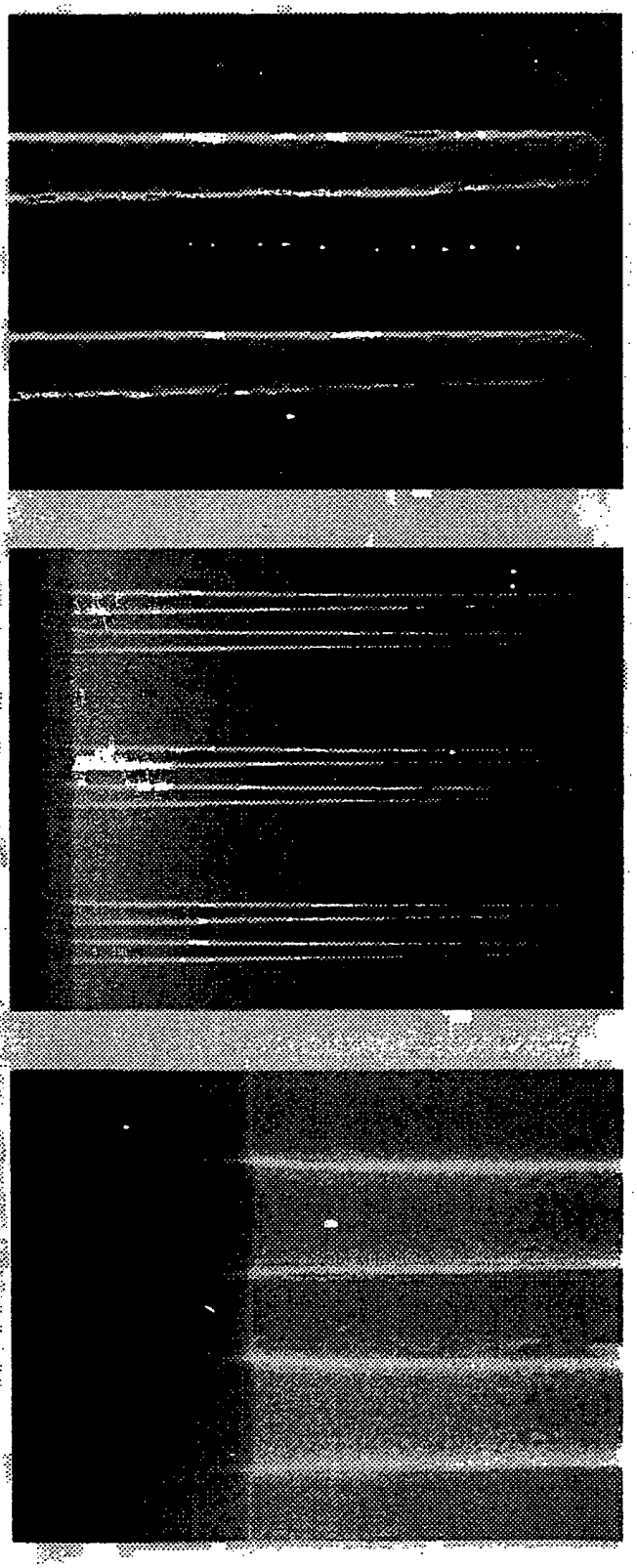


FIG. 9

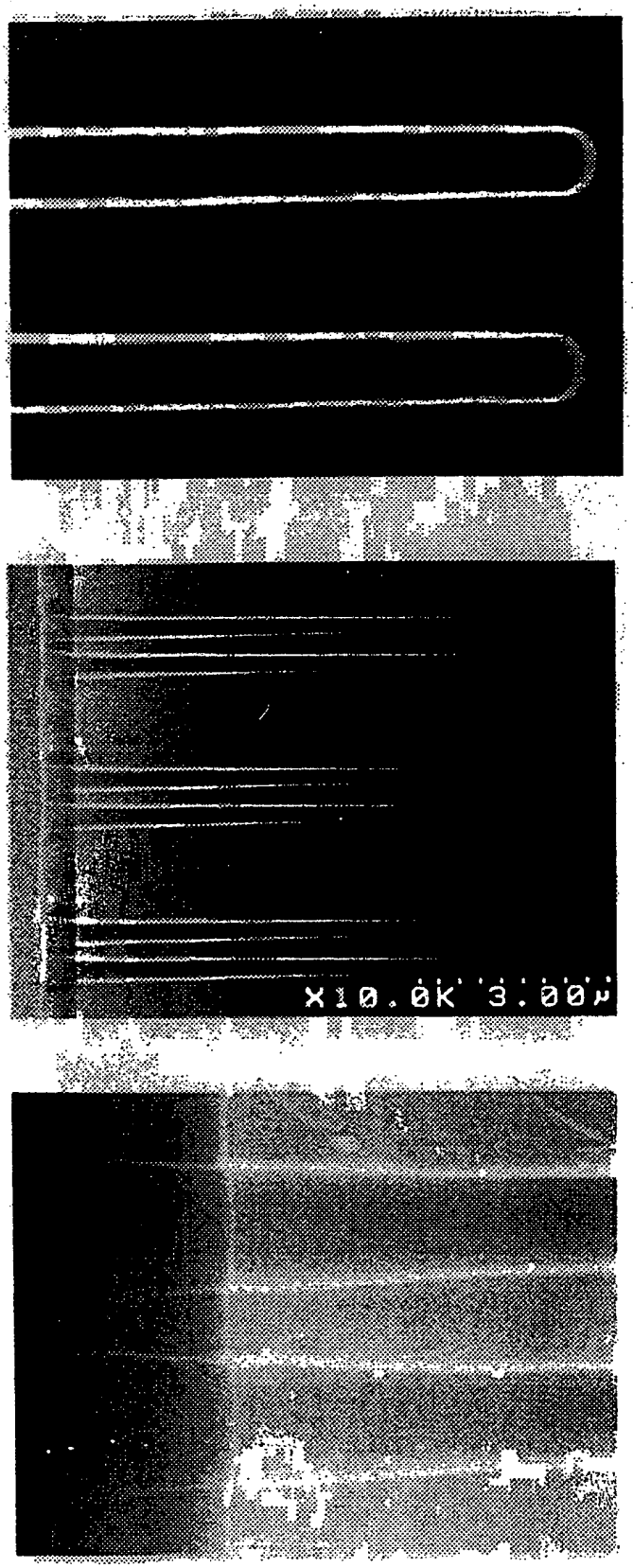


FIG. 10

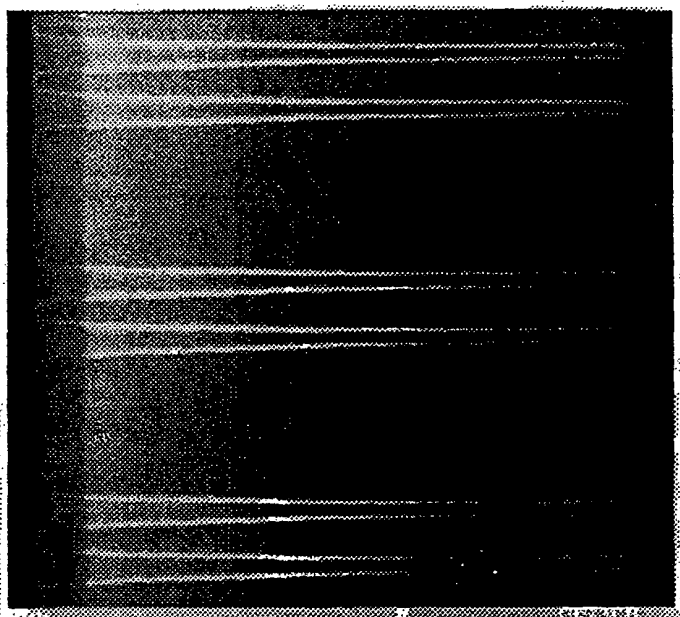


FIG. 13

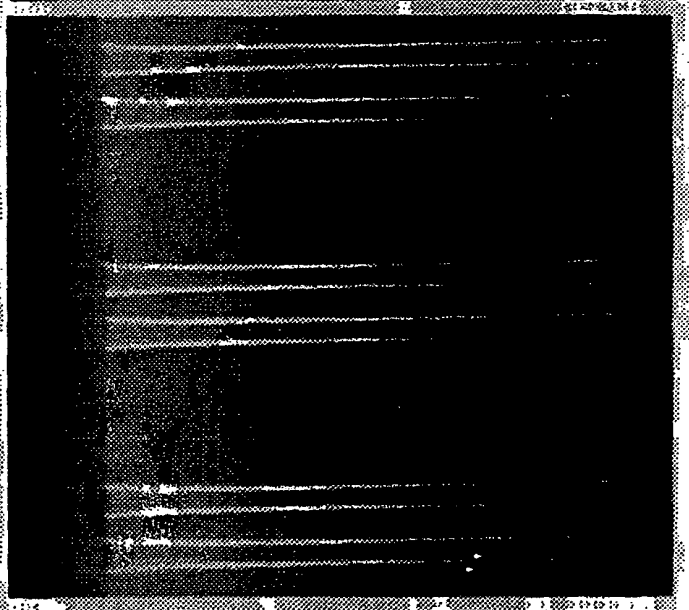


FIG. 12

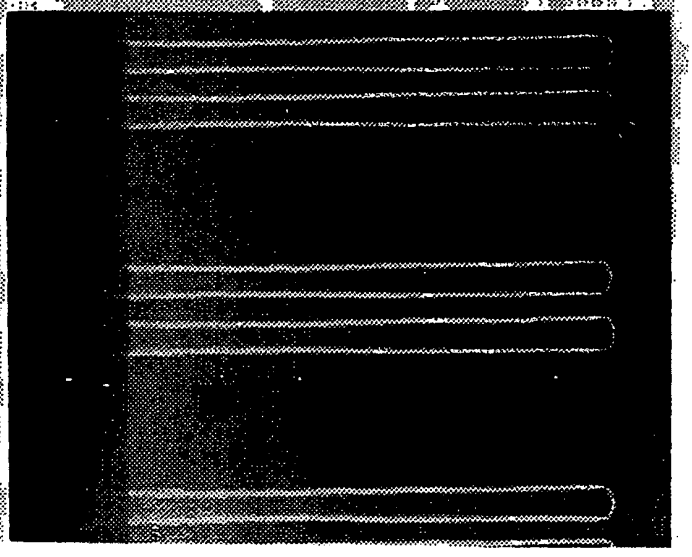


FIG. 11

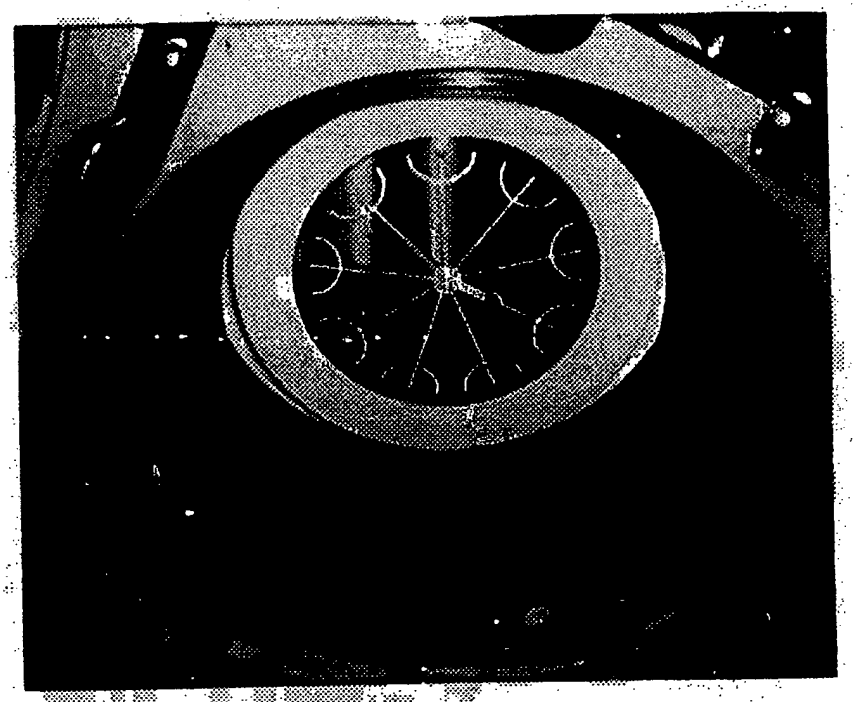


FIG. 14

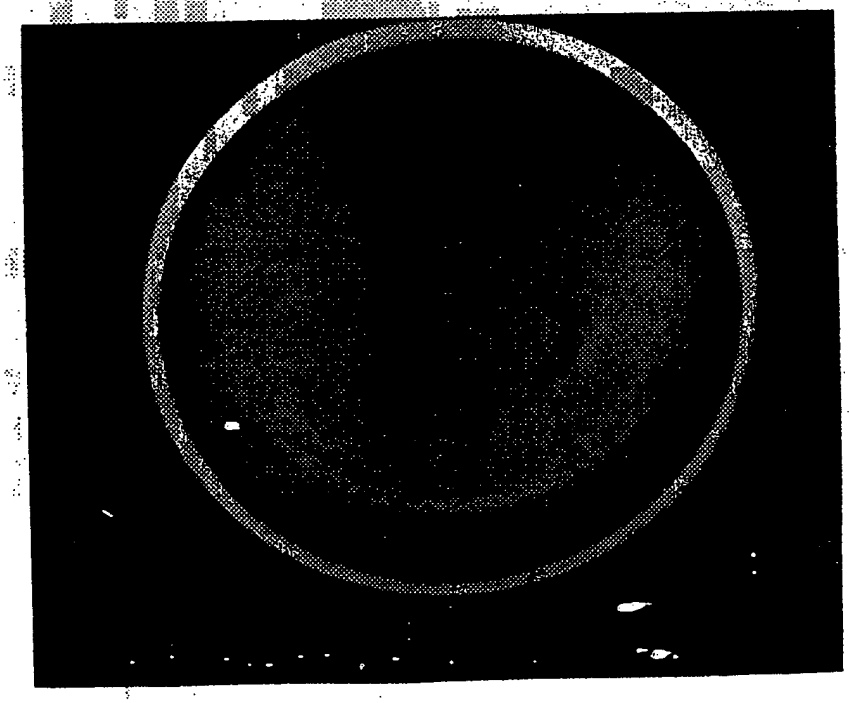


FIG. 15